Observations of Pearson-Readhead Survey Sources using VSOP and the EVN

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We present high resolution images, preliminary analysis, and interpretation from VSOP space VLBI observations of Pearson-Readhead survey sources. We will highlight several of the sources that have been observed using a combination of the HALCA spacecraft and the EVN.

astrophysics

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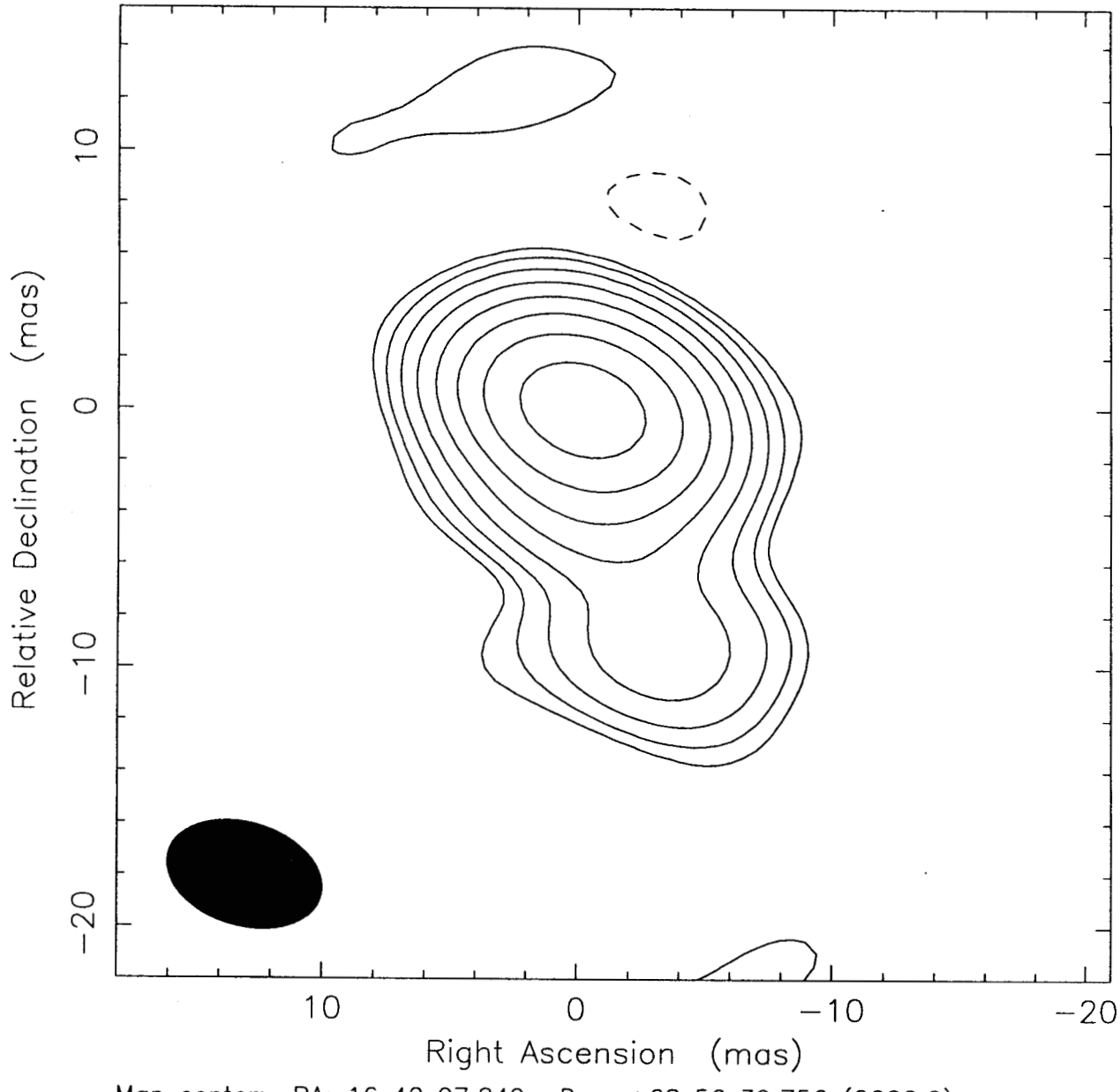
INTRODUCTION

- The VSOP mission uses an Earth-orbiting antenna (HALCA; launched 1997 February) and ground-based facilities (radio telescopes, tracking stations, and correlators) to form a VLBI array with maximum baselines of approximately 30,000 km and u-v coverage suitable for imaging.
- Observations at 5 GHz yield maximum resolution of approximately 0.2 mas, a good match to 15 GHz observations on the ground.
- For the 1^{st} VSOP Announcement of Opportunity we proposed observations of sources from the complete Pearson-Readhead (PR) sample.
- The PR sample consists of 65 extragalactic radio sources with:
  - $\delta > 35°$
  - $|b| > 10°$
  - $S_{total}(5GHz) > 1.3$ Jy
- To select our sample of 31 sources from the PR sources we add:
  - $S_{>6000km}(5GHz) > 0.4$ Jy
- To date we have completed observations of 18/31 sources. Each observation consists of data from one HALCA orbit (6 hrs) and an array of ground radio telescopes. **For 6 of these observations EVN antennas have been used.**

RESULTS

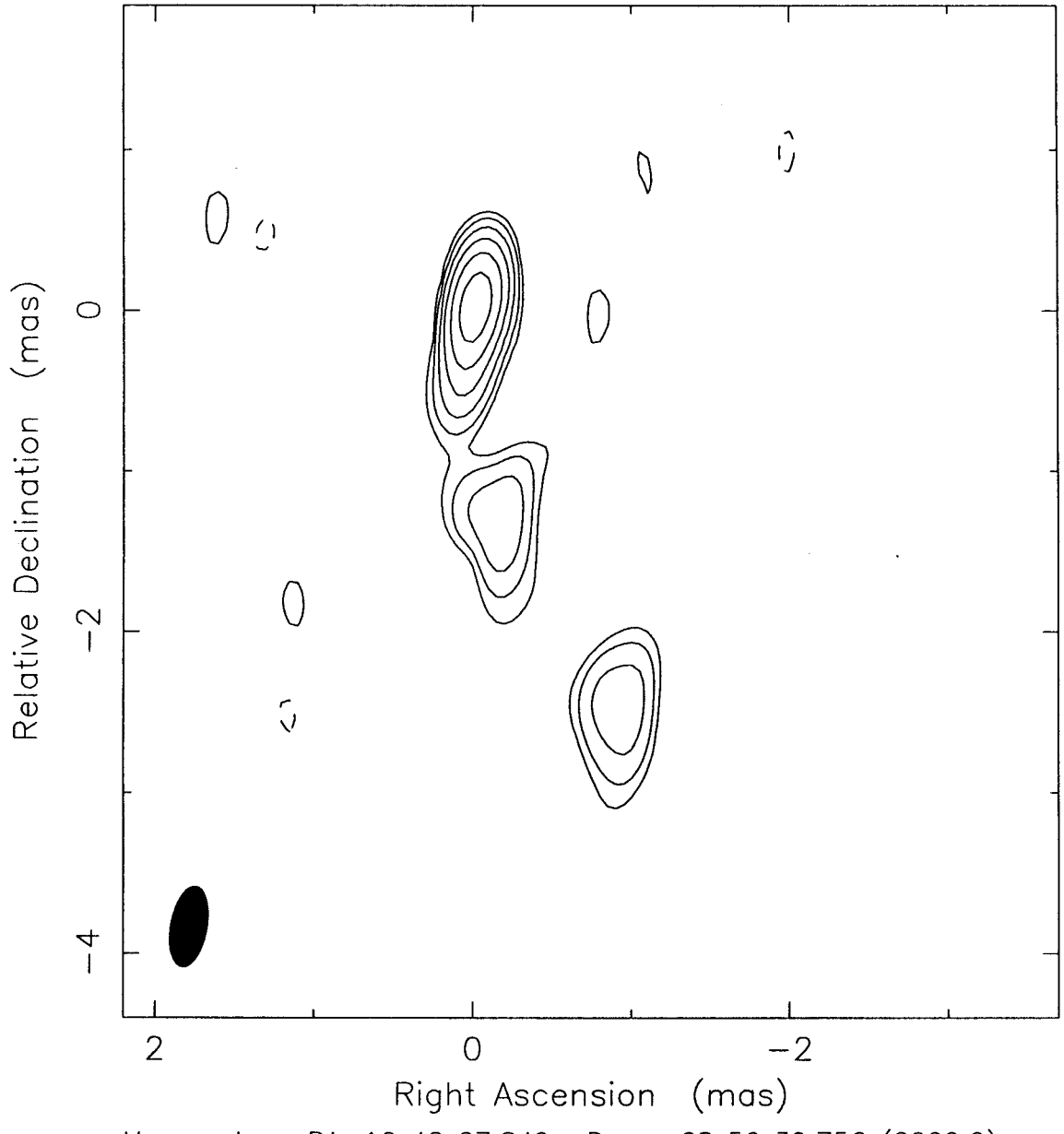
- Sources observed with VSOP/EVN observations include:
  - 1954+513
  - 2021+614
  - MKN501
  - 1642+690
  - 3C345
- We aim to measure accurate brightness temperatures (B_T) for the PR sample.
  - B_T sensitivity $\propto D^2$
  - Ground-based observations are only sensitive to $B_T \sim 10^{12}$ K $\equiv$ nominal inverse Compton limit
  - Space VLBI observations are **required** to detect $B_T > 10^{12}$ K
  - $B_T \propto \delta$
- What is the brightness temperature distribution for a complete sample of radio sources? Is there a characteristic maximum brightness temperature? How does it compare to the nominal 10^{12} K inverse Compton limit.

Clean map. Array: EJMNSTW EJMNSTW EGMNSTW EGGMNSW EGMNRSW EMNRSW
1642+690 at 4.970 GHz 1998 May 31

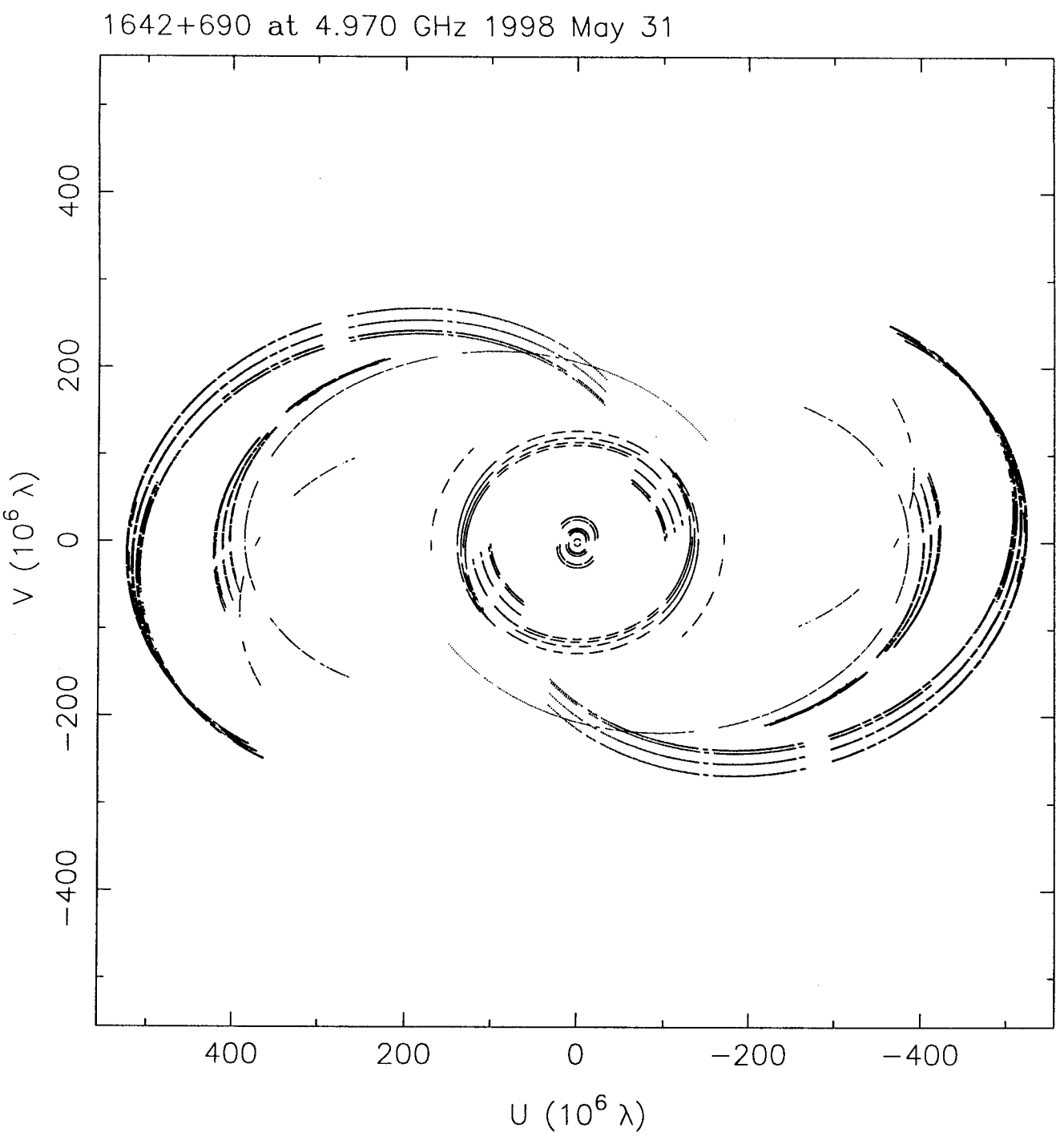


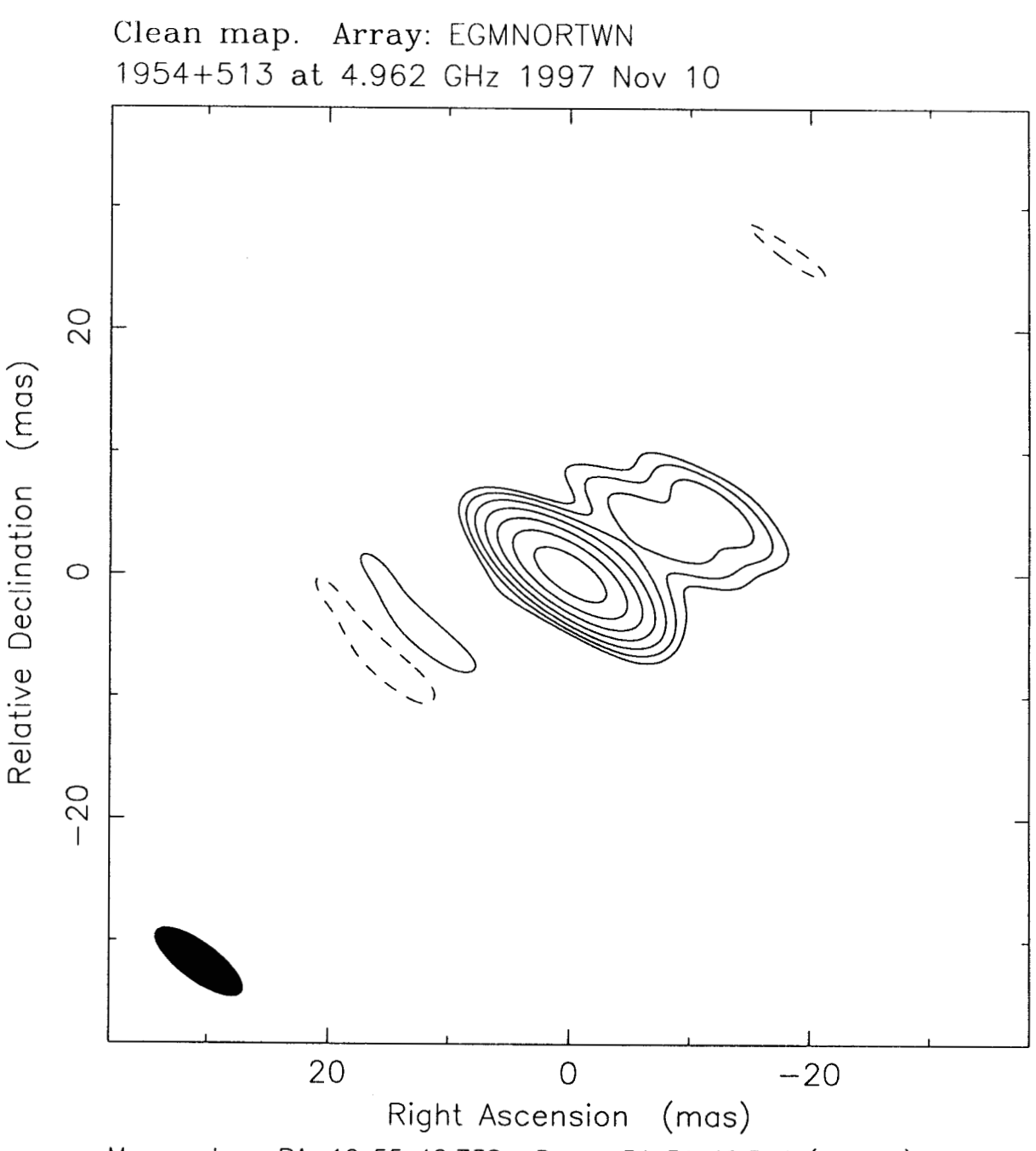
Map center: RA: 16 42 07.849, Dec: +68 56 39.756 (2000.0)
Map peak: 0.794 Jy/beam
Contours %: −0.5 0.5 1 2 4 8 16 32 64
Beam FWHM: 6.19 x 3.99 (mas) at 74.3°

Clean map. Array: EJMNSTW EJMNSTW EGMNSTW EGGMNSW EGMNRSW EMNRS
1642+690 at 4.970 GHz 1998 May 31

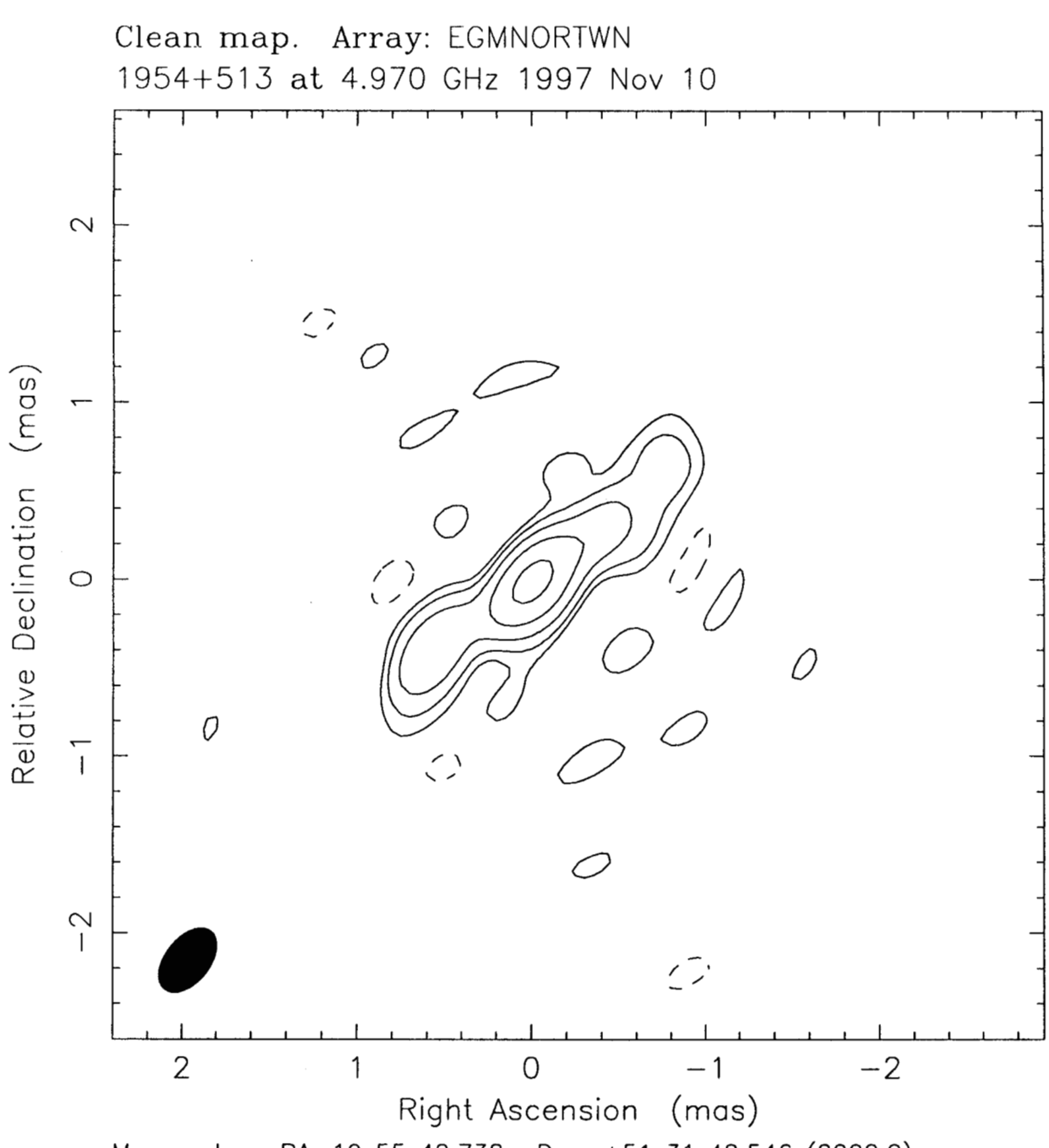


Map center: RA: 16 42 07.849, Dec: +68 56 39.756 (2000.0)
Map peak: 0.435 Jy/beam
Contours %: −2 2 4 8 16 32 64
Beam FWHM: 0.507 x 0.229 (mas) at −10.5°

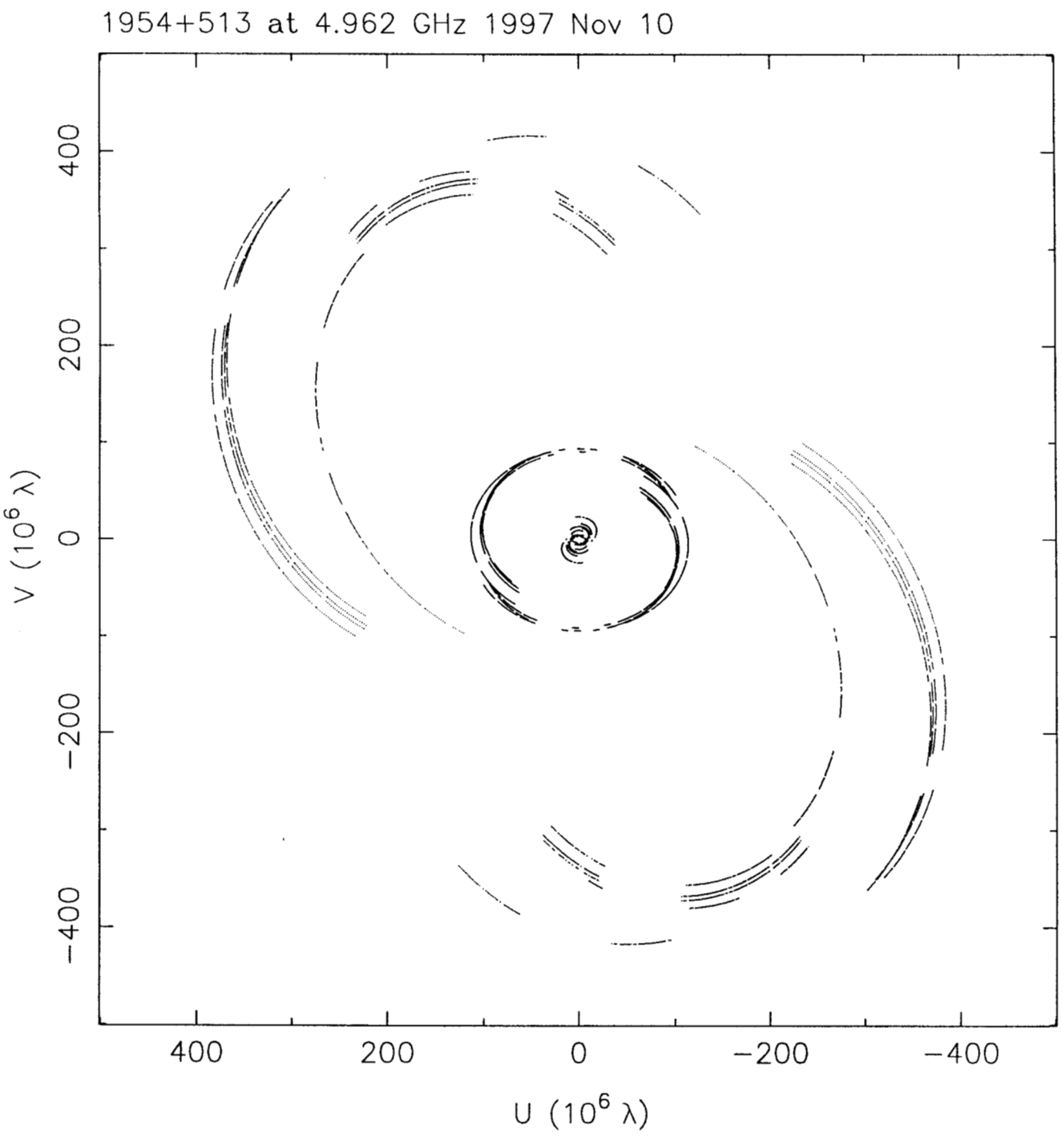

1642+690 at 4.970 GHz 1998 May 31
400
200
0
−200
−400
V (10^6 λ)
400
200
0
−200
−400
U (10^6 λ)

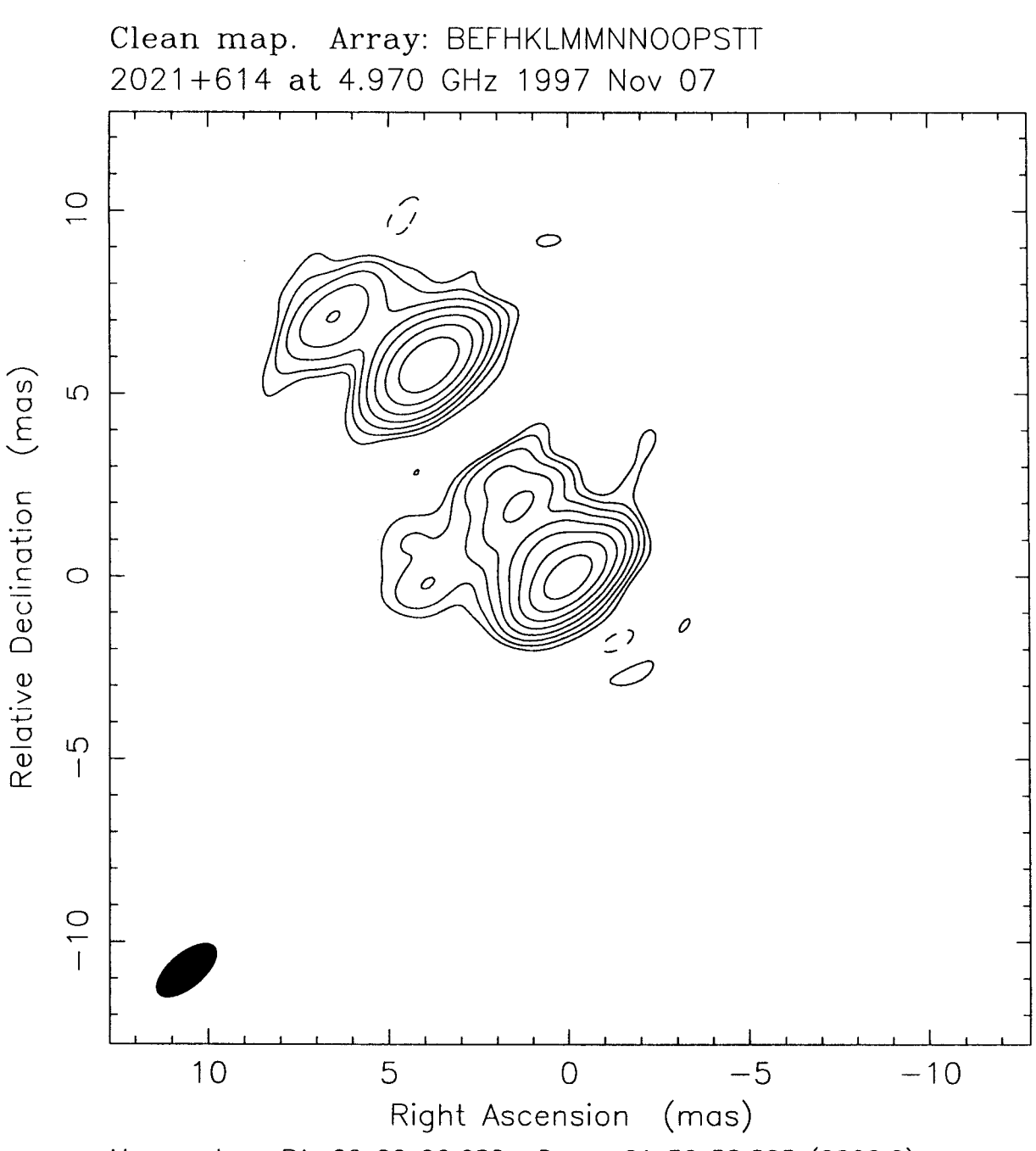


Map center: RA: 19 55 42.738, Dec: +51 31 48.546 (2000.0)
Map peak: 0.807 Jy/beam
Contours %: −1 1 2 4 8 16 32 64
Beam FWHM: 8.62 x 3.06 (mas) at 54.9°

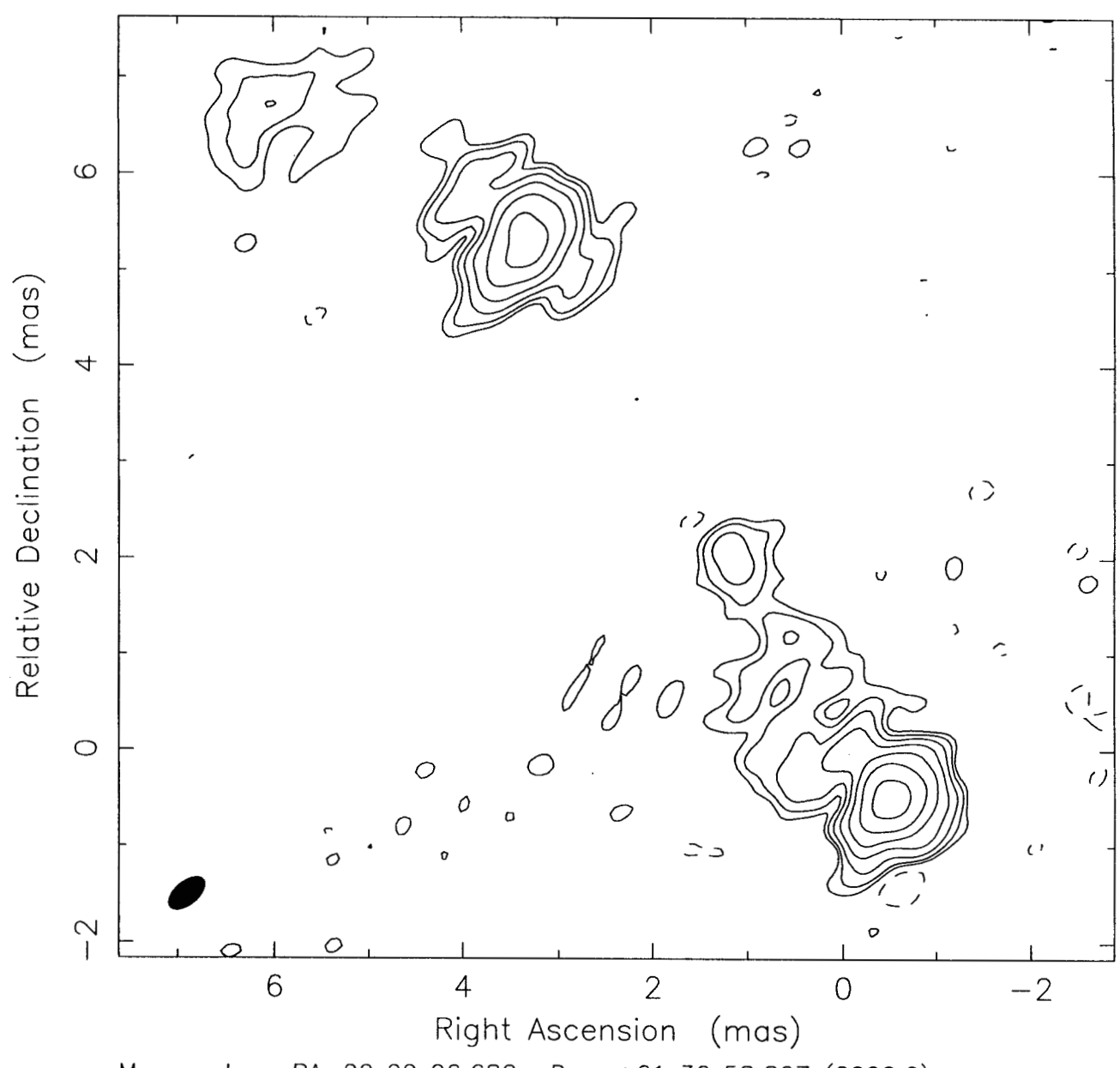


Map center: RA: 19 55 42.738, Dec: +51 31 48.546 (2000.0)
Map peak: 0.313 Jy/beam
Contours %: −5 5 10 20 40 80
Beam FWHM: 0.424 x 0.254 (mas) at −40.2°

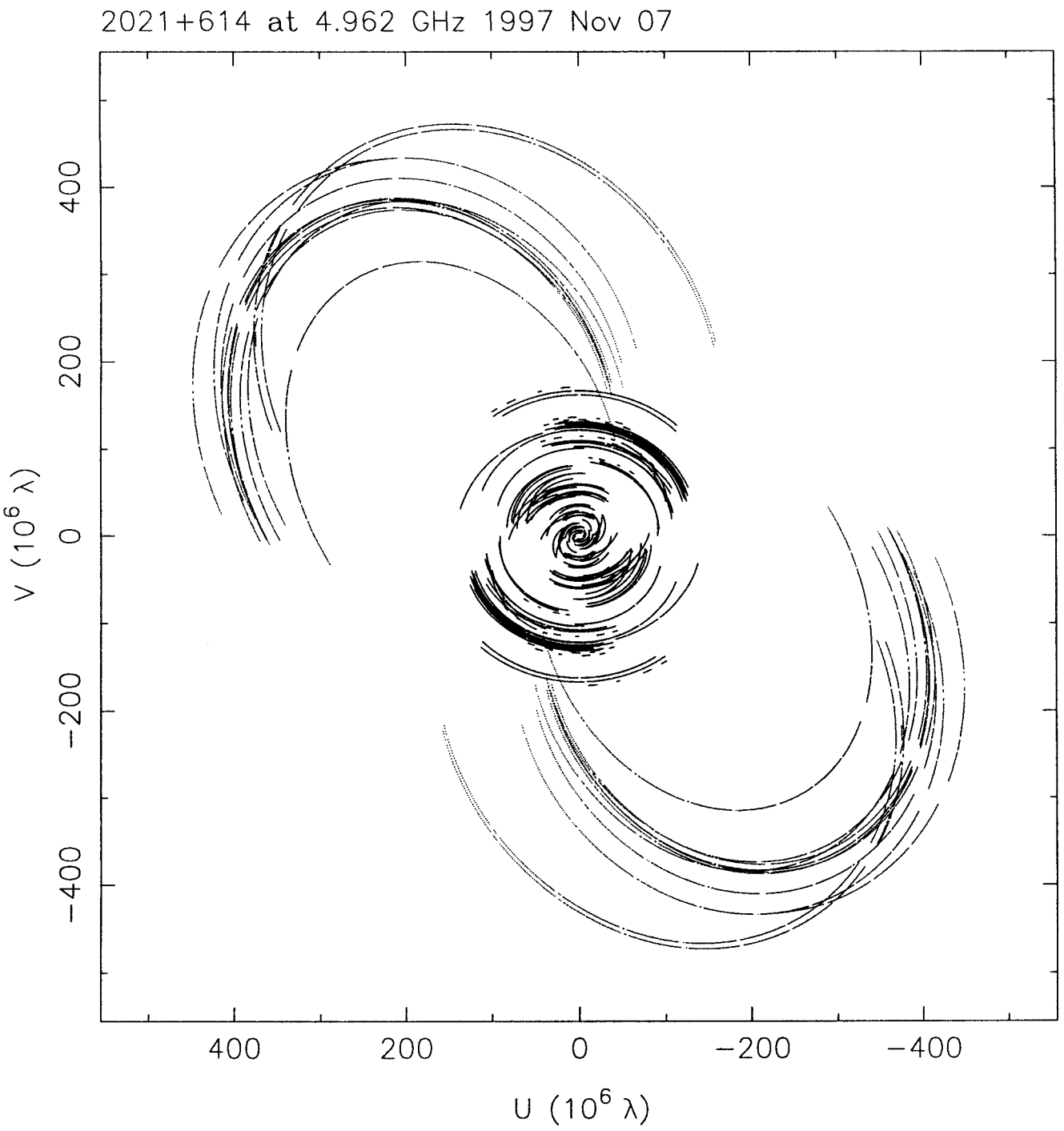

1954+513 at 4.962 GHz 1997 Nov 10
400
200
0
−200
−400
V (10^6 λ)
400
200
0
−200
−400
U (10^6 λ)

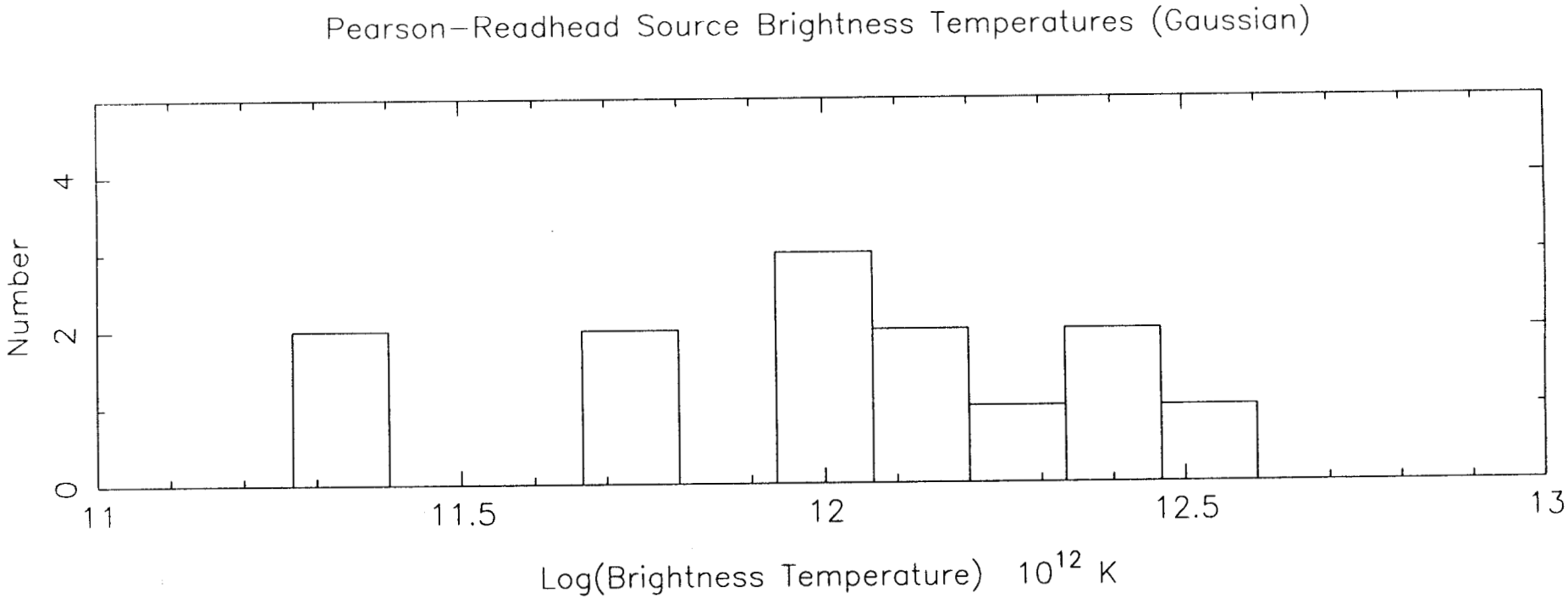


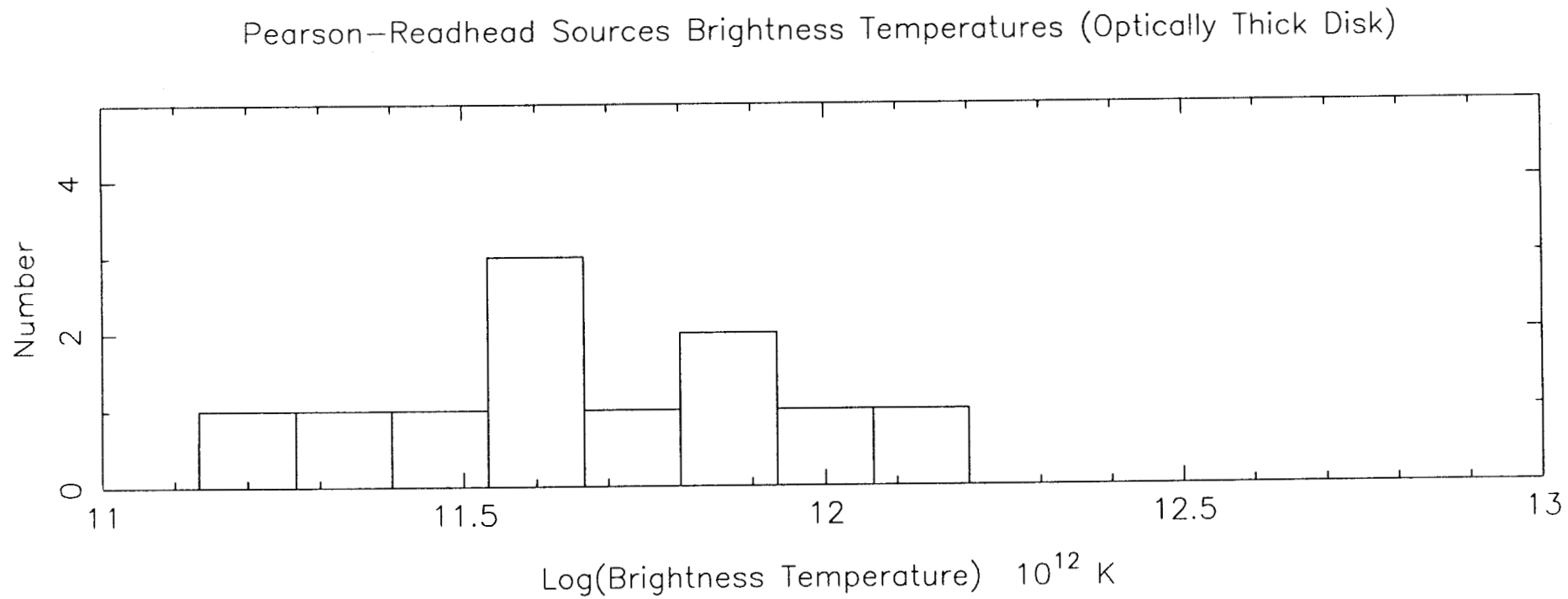
Map center: RA: 20 22 06.682, Dec: +61 36 58.805 (2000.0)
Map peak: 1.18 Jy/beam
Contours %: −0.5 0.5 1 2 4 8 16 32 64
Beam FWHM: 1.99 x 0.924 (mas) at −50.1°



Map center: RA: 20 22 06.682, Dec: +61 36 58.807 (2000.0)
Map peak: 0.367 Jy/beam
Contours %: −1 1 2 4 8 16 32 64
Beam FWHM: 0.447 x 0.234 (mas) at −50.4°


2021+614 at 4.962 GHz 1997 Nov 07
400
200
0
−200
−400
V (10^6 λ)
400
200
0
−200
−400
U (10^6 λ)


Pearson–Readhead Source Brightness Temperatures (Gaussian)
Number
0
2
4
11
11.5
12
12.5
13
Log(Brightness Temperature) 10^{12} K


Pearson–Readhead Sources Brightness Temperatures (Optically Thick Disk)
Number
0
2
4
11
11.5
12
12.5
13
Log(Brightness Temperature) 10^{12} K